
Data Redundancy Evaluation of AREMP & PIBO
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Why Conduct a Redundancy Analysis?

- Cost & time savings.
  - Reduced field effort
  - Reduced data processing effort
- Parsimony of indicators within a program.
- Reduced extraneous “noise” in the final analysis.

Additional Benefits

- Identify relationships between indicators that can be used for predictive purposes.
- Evaluate indicator relationship with objective(s).
- Converging on a common set of indicators between programs facilitates:
  - Data Sharing
  - Larger scale analyses
  - Potential integration of programs

Steps in a Redundancy Analysis…

1. Look for correlations between indicators.
2. Use Principle Components Analysis (PCA) to reduce indicators.
3. Evaluate
    1. Coefficient of Variation (CV)
    2. Total Variation
    3. Signal to Noise ratio (S/N)
    4. Sensitivity to change
    5. Relation to Objectives
4. Eliminate indicators as appropriate.
5. Document the elimination & the decision process.

AREMP Redundancy Analysis

- Correlations for *dependent* indicators with $\rho \geq |0.50|$:
  - (+) Bankfull Width, Bankfull Width:Depth, Site Length
- Only two correlations for *independent* indicators with $\rho \geq |0.50|$:
  - (-) Pool Frequency & BF Width
  - (+) Conductivity & pH

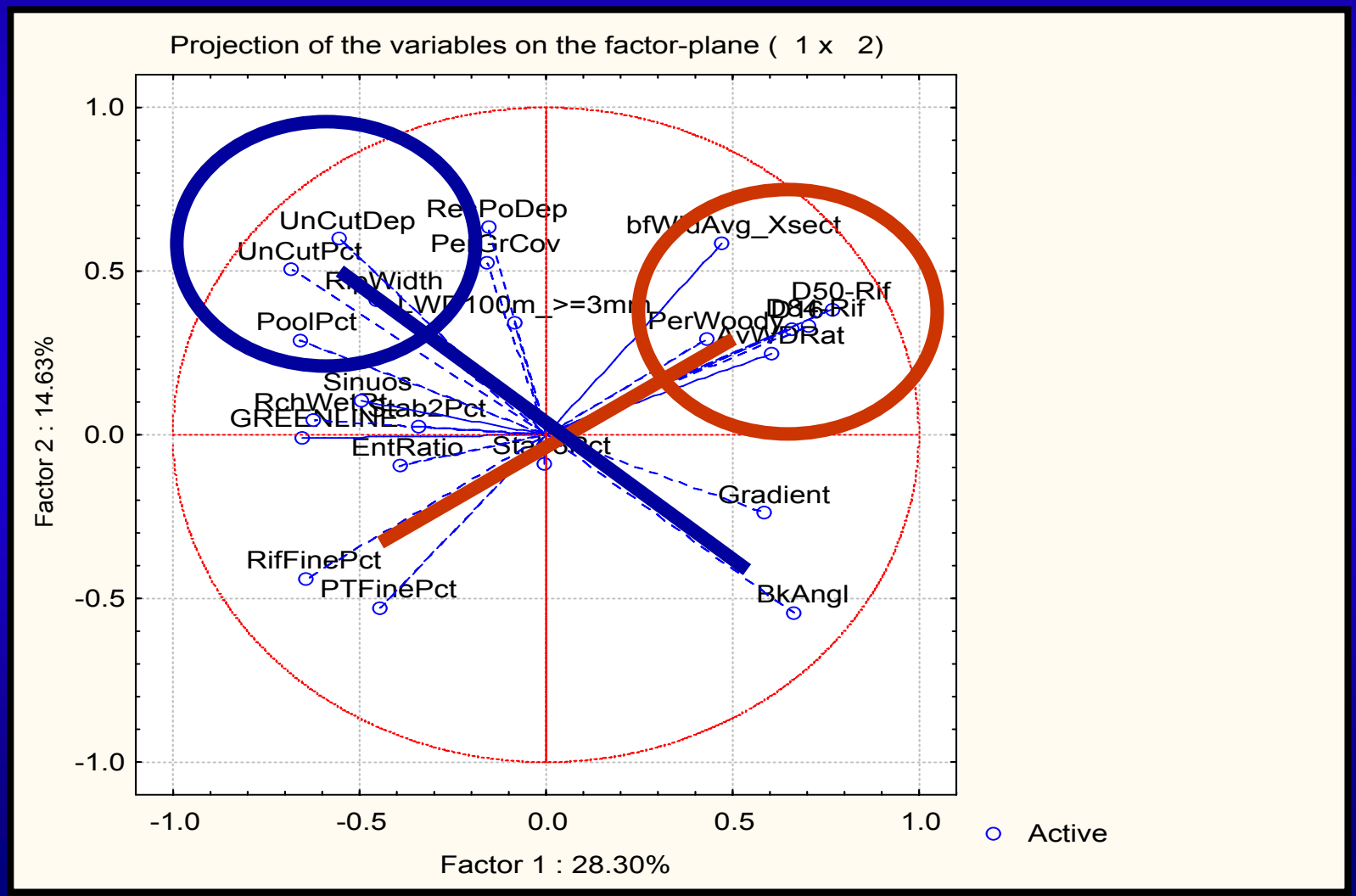
PIBO Redundancy Analysis

- Correlations for *dependent* indicators with $\rho \geq |0.50|$:
  - (±) D16, D50, D84, % Riffle Fines
  - (+) Bankfull Width, Bankfull Width:Depth
- Correlations for *independent* indicators with $\rho \geq |0.50|$:
  - (±) Bank Angle, Undercut (UC) Bank, % Undercut Bank
  - (-) % PTC Fines, D50
  - (+) Bankfull Width, D50
  - (-) Gradient, % Pools

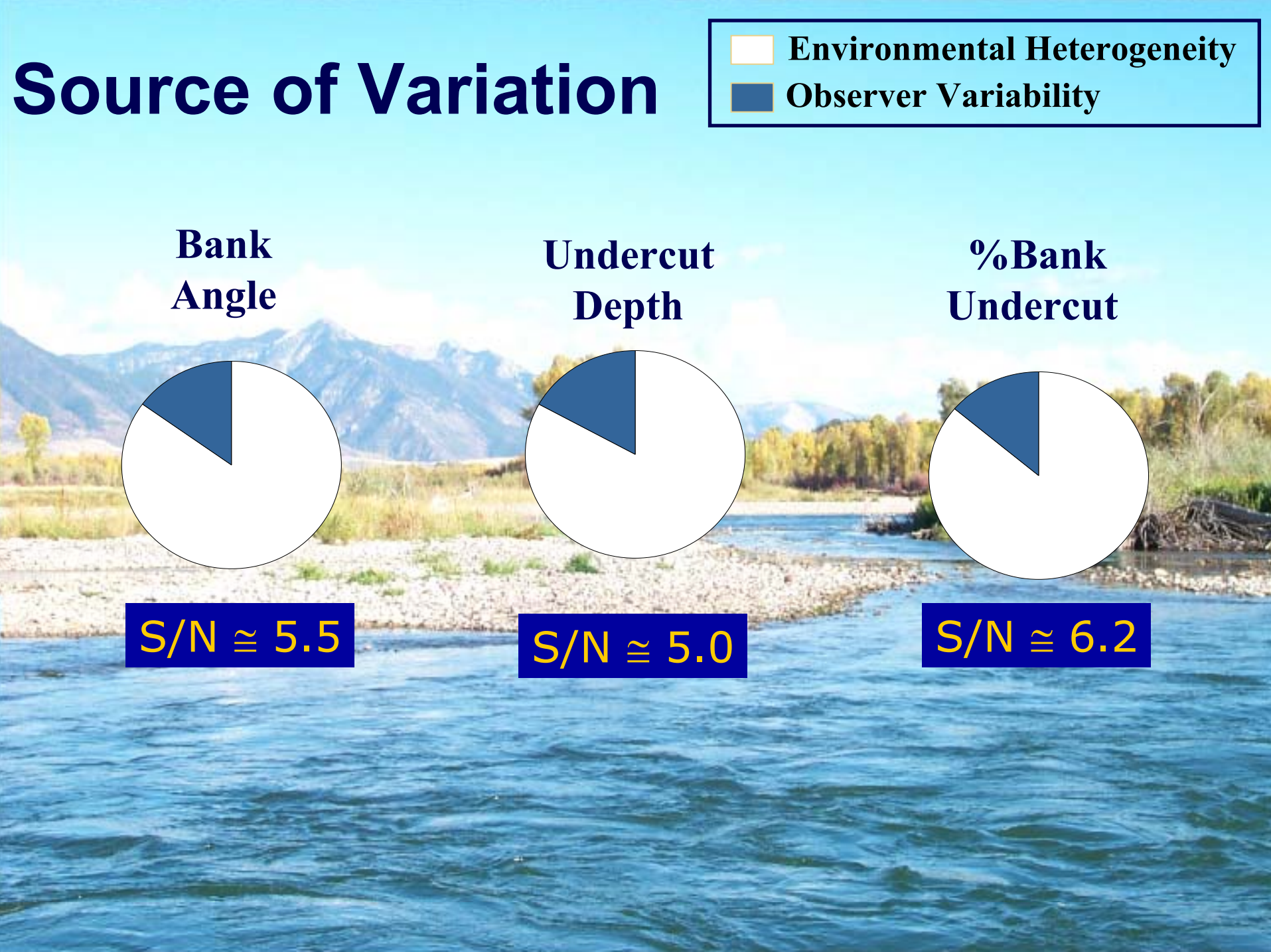
Bank Indicator Correlations

	Bank Angle	UC Bank Depth	Percent UC Bank
Bank Angle	1.00		
UC Bank Depth	-0.86	1.00	
Percent UC Bank	-0.95	0.88	1.00

PCA


Projection of the variables on the factor-plane (1 x 2)
1.0
0.5
0.0
-0.5
-1.0
Factor 2 : 14.63%
-1.0
-0.5
0.0
0.5
1.0
Factor 1 : 28.30%
UnCutDep
UnCutPct
PoolPct
Sinuos
EntRatio
Gradient
RifFinePct
PTFinePct
BkAngl
D50-Rif
Active

Source of Variation



Bank Indicator Stats

ATTRIBUTE	CV	S/N	DIF
Bank Angle	22	5.5	15%
UC Bank Depth	43	5.0	35%
% UC Bank	48	6.2	28%

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Conclusions…

- AREMP – Little to no redundancy between indicators
- PIBO – Retain UC Bank Depth = status in populations
  - Retain Bank Angle = trend in populations
- BOTH – Relate indicators to specific objectives or components of objectives.

Relation to Watershed Processes…

- Indicators from a master list evaluated
- Evaluation criteria included:
  - Wide spread use/acceptance of indicators.
  - Indicator sensitivity to environmental change.
  - Relationship to meeting objective(s) of the program.

Theoretical Rates of Change for Low Gradient Reaches

Rate of Change

Fast → Slow

Attribute Character	Channel Character	Geomorphic Character
Substrate Size	Bank Stability	Sinuosity
Large Wood Numbers	Habitat Composition	Gradient
Biota numbers	Residual Depth	

Sensitivity to Change

- Adding Sediment <2 mm

Response Variable	C	SP	PB	PR
Bankfull Width	●	●	●	■
Thalweg Profile	●	■	●	◆
D50	●	●	◆	◆
Percent Fines	■	■	◆	◆
Habitat Units	●	●	●	■

◆ Very Responsive

■ Secondary Response

● Little Response

Montgomery and MacDonald 2002

Discussion Topics

- Are these select suites of indicators (AREMP & PIBO) the “best” surrogates for watershed processes?
- At what temporal scale can change be detected?
- What is the natural range of variation in the indicators?
- Given the natural variation, how sensitive are the indicators to change?